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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/579,762	01/30/2007	Markus Pridoehl	290430US0X PCT	8391
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OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			EXAMINER LIAO, DIANA J	
			ART UNIT	PAPER NUMBER
			1793	
			NOTIFICATION DATE	DELIVERY MODE
			06/29/2009	ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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<b>Office Action Summary</b>	<b>Application No.</b> 10/579,762	<b>Applicant(s)</b> PRIDOEHL ET AL.	
	<b>Examiner</b> DIANA J. LIAO	<b>Art Unit</b> 1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 01 April 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 1-8, 12 and 23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 9-11 and 13-22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/8/06, 3/30/07, 10/4/07, 9/12/08</u> .                       | 6) <input type="checkbox"/> Other: _____                          |



## **DETAILED ACTION**

### ***Election/Restrictions***

1. Applicant's election with traverse of group II, species (a), claims 9-11 and 13-22, in the reply filed on 4/1/2009 is acknowledged. The traversal is on the ground(s) that there is no search burden and there was no reasoning for the restriction requirement. This is not found persuasive because as was discussed in the restriction requirement, aggregated silicon powders of high surface area are known in the art. Thus a lack of unity exists.

The requirement is still deemed proper and is therefore made FINAL.

2. Claims 1-8, 12 and 23 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected inventions and species, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on 4/1/2009.

### ***Claim Objections***

3. Claims 9-11 and 13-22 are objected to because of the following informalities: These claims depend upon a withdrawn claim. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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5. Claim 22 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 22 recites that "the thermal post-treatment" is carried out in the presence of at least one doping substance. The preceding claims mention a thermal post-treatment of the reaction mixture, and then a second post-treatment (claim 21). The two post-treatments need to be clearly differentiated.

***Claim Rejections - 35 USC § 103***

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. Claims 9-11 and 13-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over FR 2591412 in view of Marra ("Homogeneous Nucleation and Growth of Silicon Powder", 1983, obtained from

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<http://dspace.mit.edu/handle/1721.1/35323>) and Miller, et al. ("Lithium Doping of Polycrystalline Silicon", 1980).

FR '412 teaches a method for producing a sub micron powder utilizing microwave plasma. The products are cooled after creation and collected. (abstract) The method can be applied to the decomposition of gases, such as  $\text{SiH}_4$  into silicon and hydrogen. The reaction is performed at a range of temperatures, from room temperature to hundreds of degrees Celsius. (pg. 6, lines 20-32) The method is preferably performed utilizing an argon gas. (pg 4, lines 33-34) The reactor is evacuated, and then the pressure is raised to 1.3 bar (1300 mbar) with inert gases. (pg 4, line 36 – pg 5, line 6)

Regarding the pressure of the reactor, FR '412 teaches a slightly higher value than the claimed range. However, process conditions such as pressure would have been obvious to optimize to one of ordinary skill in the art. If the general conditions of a process are taught, a difference in ranges from optimization is generally not found to be patentable.

Regarding the amount of silane, hydrogen, or argon, it would have been obvious to one of ordinary skill in the art to adjust the amounts to create the desired product. Regarding the inclusion of hydrogen at various points in the process, hydrogen is known in the art as a diluent or inert gas. Since one of the by products of the decomposition of silane is hydrogen, it would have been an obvious choice to utilize it as a diluent gas to reduce the number of different gases in the end to dispose of and also in order to help control the kinetics of the reaction by manipulating the equilibrium.

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FR '412 does not teach the use of a dopant. FR '412 also does not appear to specifically teach thermal post-treatments in a hot wall reactor. FR '412 is silent regarding the surface area of the product.

Marra teaches a process of making silicon powder from the decomposition of silane gas. The particles created were less than 150nm and loosely agglomerated. At higher reaction temperatures the product was found to be completely crystalline. The particles fulfill many of the requirements for an ideal sinterable powder; they are fine, loosely agglomerated and of high purity. (pg 2-3, abstract) Silicon made from run 631S was found to have a surface area about 42.6 or 44.3 m<sup>2</sup>/g. (Table A3.1, pg 221) The surface areas of these products are found to be substantially close enough to 50 m<sup>2</sup>/g. The value of "44.3" would have suggested to one of ordinary skill in the art a slightly higher value based upon a reasonable expectation of success, *In re O'Farrell*, 853 F.2d 894, 904, 7 USPQ2d 1673, 1681 (Fed. Cir. 1988).

Run 631S was conducted at with a max temperature of about 1200°C. (Appendix I, pg 213) The created silicon is nearly completely crystalline when the maximum reaction zone temperature reaches above about 1150°C. (Fig IV.46, pg 199) Therefore, Marra appears to teach a product that is both crystalline and possesses high surface area.

A dopant was also added during some runs in the gas phase directly into the reactant stream. Introducing the dopant in this manner allows for uniform distribution. Boron is known to help the sinterability of silicon. (pg 74) Specifically disclosed was the

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use of a boron dopant in the form of diborane,  $B_2H_6$ . With toxicity as a factor, the amount of boron was kept very low, with a 2/1  $SiH_4$  to (1.0%  $B_2H_6$  + 99.0% Ar mixture) ratio. (pg 75)

Regarding a lithium dopant, Miller, et al. teaches that doping silicon with lithium increases its conductivity and minority-carrier lifetime, useful in the field of solar cells. Although the method explored in Miller, et al. is a salt bath, lithium doping methods such as lithium metal evaporation should also work. (pg 1100) Therefore, it would have been obvious to incorporate a lithium doping element in order to create a silicon better suited for solar cells. Regarding the use of a dopant in the original reactant mixture and the type of doping substance, since the dopant is only optionally included in the mixture as recited by claim 9, it is not positively required. Alternatively, Marra generally teaches the doping of silicon in its process. Miller, et al. teaches that lithium is also a known dopant which imparts useful properties onto silicon. Since Marra teaches that it is advantageous to introduce the dopant in the gaseous phase, it would have been obvious to both combine the useful lithium dopant with the silicon produced in Marra and also to introduce it in the gaseous phase. Regarding the form of lithium-containing gas, it would have been obvious to use any gas appropriate known to one of ordinary skill in the art. For example, in Marra, boron is introduced as  $B_2H_6$ , allowing for hydrogen to be the byproduct, which is already present as a byproduct in the system from the silane. Miller, et al. teaches that lithium metal evaporation, which is elemental lithium.



Regarding thermal post treatments, including a step with doping, it would have been obvious to one of ordinary skill in the art to employ known processing techniques. Crystalline powders are commonly annealed or heated in order to increase crystallinity, grow grain size, or to purify the product. The use of several heat treatment steps is not found patentable over the prior art. It would have been obvious to subject the product of FR '412 to a thermal post treatment to obtain a crystalline product as desired in Mara.

Miller, et al. teaches a process in which silicon is created first before lithium is added as a dopant (pg 1101), demonstrating that it is known and possible to do so in the art post production. Regarding the use of a hot wall reactor, it would have been obvious or known to one of ordinary skill in the art to use any suitable reactor for a process.

Therefore, claims 9-11, and 13-22 are not found patentable over the prior art.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DIANA J. LIAO whose telephone number is (571)270-3592. The examiner can normally be reached on Monday - Friday 8:00am to 5:30pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 571-272-1358. The fax phone

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number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ngoc-Yen M. Nguyen/  
Primary Examiner, Art Unit 1793

DJL